Transactions of the Royal Society of S. Aust. (1995), **119**(2):89-94

A REVISION OF THE GENUS *TIKUSNEMA* (NEMATODA: ACUARIOIDEA) WITH THE DESCRIPTION OF A NEW SPECIES FROM THE FALSE WATER-RAT *XEROMYS MYOIDES* FROM QUEENSLAND.

by LESLEY R. SMALES*

Summary

SMALES, L. R. (1995) A revision of the genus *Tikusnema* (Nematoda: Acuarioidea) with the description of a new species from the false water-rat, *Xeromys myoides* from Queensland. *Trans. R. Soc. S. Aust.* **119**(2), 89-94, 31 May, 1995.

The genus *Tikusnema* Hasegawa, Shiraishi & Rochman, 1992 is redescribed. The species *Molinacuaria indonesiensis* Gibbons, Crawshaw & Rumpus, 1992 was found to be synonymous with *Tikusnema javaense* Hasegawa, Shiraishi & Rochman, 1992, the two species having been described almost simultaneously from the rice field rat, *Rattus argentiventer*. A new species of *Tikusnema* from the false water-rat *Xeromys myoides* is described. *Tikusnema vandycki* sp. nov. can be distinguished from *T. javaense* by the size of the adult male and female, the shape of the cuticular leaves on the pseudolabia, the length of the male tail and spicules, the length of the female tail and size of eggs. The implications of the presence of acuarid nematodes, normally found in birds, in a range of small mammalian hosts, are discussed. The significance of the presence of *Tikusnema* in Indonesian and Australian hosts cannot be determined until its presence or absence on the island of New Guinea is confirmed.

KEY WORDS: *Tikusnema*, Nematoda, Acuarioidea, *Xeromys myoides*, false water-rat, mammalian hosts.

Introduction

The false water-rat *Xeromys myoides* Thomas, 1889 is a small dark grey semi-aquatic rat whose preferred habitat is shallow coastal wetlands, such as swamps, mangroves, forests, lagoons, or sedged lakes (Van Dyck 1994). They are currently known from only six sites in north-central and north-eastern Australia. Their current conservation status is vulnerable and likely to progress to endangered because of human proclivity to drain and develop swamps (Van Dyck 1992). They forage on the mud flats for food items including aquatic invertebrates, such as crabs, mud-lobsters, mussels, marine pulmonates and polyclads (Van Dyck 1994).

Nematodes dissected from specimens of *X. myoides*, collected by staff of the Queensland Museum were found to be species belonging to the Acuarioidea. The genus *Tikusnema* was erected for specimens from *Rattus argentiventer* (Robinson & Kloss, 1916), the rice field rat from West Java by Hasegawa *et al.* (1992). Almost simultaneously a new species of *Molinacuaria* was described, also from *R. argentiventer* from Java, by Gibbons *et al.* (1992).

Comparison of material from *X. myoides* with type specimens of both species described from *Rattus argentiventer* suggest that the nematodes from *X. myoides* are new species of *Tikusnema* while all the material from *R. argentiventer* is con-specific. *Molinacuaria indonesiensis* therefore falls as a synonym of *Tikusnema javaense*.

Materials and Methods

Six false water-rats, *Xeromys myoides*, were collected from Myora Swamp, Stradbroke Island, Queensland during 1992. Faecal pellets from two hosts were examined. The alimentary tracts of the four other hosts were dissected for helminth parasites after the bodies had been fixed whole in 10% formalin. The nematodes so collected were cleared in lactophenol for microscopic examination. Figures were drawn with the aid of a drawing tube. Measurements, of 10 specimens in μm unless otherwise stated, with the range followed by the mean, were made with the aid of an ocular micrometer, drawing tube and measuring wheel.

Specimens of *Molinacuaria indonesiensis* Gibbons, Crawshaw & Rumpus, 1992 and *Tikusnema javaense* Hasegawa, Shiraishi & Rochman, 1992 from *Rattus argentiventer* were also examined for comparison.

The terminology used for morphological features in the descriptions is that of Bird and Bird (1991) and the taxonomic system of Anderson (1992) is followed. Abbreviations are: Queensland Museum QM; Australian Helminthological Collection South Australian Museum SAM; United States National Museum Helminthological Collection USNM; International Institute for Parasitology IIP.

* Biology Department, Central Queensland University, Rockhampton 4702 Queensland.

Systematics

Order Spirurida
Suborder Spirurina
Superfamily Acuarioidea
Family Acuariidae
Sub family Seuratiinae
Genus *Tikusnema* Hasegawa, Shiraishi & Rochman, 1992

Type species *Tikusnema javaense* Hasegawa, Shiraishi & Rochman, 1992.

Tikusnema
Hasegawa, Shiraishi & Rochman, 1992.

Revised generic diagnosis

Cephalic end inflated and set off from body by constriction. Oral opening laterally compressed. Pseudolabia large, triangular in lateral view, each with two cephalic papillae and an amphid. Pseudolabia attached to each other apically, separated dorsally and ventrally by cordons and indented deeply at level of anterior extremity of cordons. Posterior end of each pseudolabium forms two cuticular leaves each subdivided into teeth. Cordons small, not extending posteriorly. Buccal capsule long, cuticular wall thick, not striated. Pharynx divided into anterior muscular and posterior glandular portions. Deirids small, bicuspid. A pair of cuticular ornamentations present laterally, posterior to deirids. Parasitic in the stomach or intestine of rodents.

Tikusnema javaense
Hasegawa, Shiraishi & Rochman, 1992.

Synonym *Molinacuaria indonesiensis* Gibbons, Crawshaw & Rumpus, 1992: pp. 175-181.

Material examined

From *R. argentiventer*: 1 ♂ allotype *Tikusnema javaense* USNM 82223 Pusakanagara, West Java, Indonesia; 1 ♂ paratype IIP B1055B from Sukamandi, West Java, Indonesia.

Description

As in Hasegawa *et al.* (1992). From the combined measurements of both Hasegawa *et al.* (1992) and Gibbons *et al.* (1992) the dimensions become as follows:

Male: length 9-21 mm, width 277-440. Buccal capsule 359-490 long, muscular portion of pharynx 410-560, glandular portion 1130-1980 long. Deirids 296-440, nerve ring 450-560, excretory pore 525-830 from anterior end. Right spicule 190-210, left spicule 491-570 long; tail 556-990 long.

Female: length 11.0-24.5 mm, width 293-510. Buccal capsule 330-490 long, muscular portion of pharynx 402-630, glandular portion 860-2030 long. Deirids 273-430, nerve ring 410-630, excretory pore 502-870 from anterior end. Vulva 5.02-12.21 mm from anterior end. Tail 230-520 long. Eggs 28-31 by 38-44.

Remarks

Tikusnema javaense and *M. indonesiensis* were described almost simultaneously by Hasegawa *et al.* (1992) and Gibbons *et al.* (1992), the descriptions appearing in different journals. Both descriptions referred to material collected on the island of Java from *Rattus argentiventer*. A careful examination of the descriptions given by each group of authors, together with a comparison of the material they examined, has revealed that they are of the same species. Any differences in measurements between the two sets of material relate only to the fact that the specimens described by Hasegawa *et al.* (1992) were smaller than those described by Gibbons *et al.* (1992). The females described by Gibbons *et al.* (1992) for example are larger, gravid females containing embryonated eggs while the smaller females described by Hasegawa *et al.* (1992) contain unfertilized eggs.

Hasegawa *et al.* (1992) describe and figure a pair of cuticular ornamentations much larger than the deirids in the adult worms and even more prominent in the 4th stage larva. Gibbons *et al.* (1992) did not mention this feature in their description of their more mature worms. Therefore it appears that the cuticular ornamentations may be a more prominent feature of juvenile than mature worms. This would account for their apparent absence in the specimens examined by Gibbons *et al.* (1992).

The interpretation of the cephalic ends of the specimens, in particular the origins of the cuticular leaves, by Hasegawa *et al.* (1992) appears consistent with both sets of material. As discussed in Hasegawa *et al.* (1992) the cuticular leaves of *Tikusnema* originate directly from the pseudolabia without separating furrows. *Tikusnema* also has small cordons not extending posteriorly. By contrast the genus *Molinacuaria*, although characterized by the absence of pseudolabia (Wong & Lankaster 1985), does have grooves located immediately anterior to ptilina. *Molinacuaria* can be further differentiated from *Tikusnema* by a lack of cordons. *Molinacuaria indonesiensis* therefore falls as a synonym of *Tikusnema javaense*. The species name *javaense* has priority because it was published in October 1992, while *indonesiensis* did not appear until in November of that year.

Tikusnema vandycki sp. nov.
FIGS 1-16

Material examined

From *Xeromys myoides*: 54 immature adults and fourth stage larvae, 31 anterior ends, 40 mature ♂♂, 26 mature ♀♀ from Myora Swamp, Stradbroke Island, Queensland.

Description

Long, slender worms with tapered extremities, cuticle thin, with fine annulations. Lateral alae absent. Cephalic cuticular leaves each divided into 4-5 teeth, lateral tooth largest (Figs 2,3,5,16). Cordons rod-like in dorso-ventral view (Fig. 2). Cordons and dorsal and ventral rim of pseudolabia faintly striated (Figs 2,8). Muscular portion of pharynx narrower and shorter than glandular portion, pharynx about 1/7 body length (Figs 1,15). Nerve ring near anterior end of muscular portion, excretory pore posterior to nerve ring. Deirids tiny, bifid, between nerve ring and excretory pore (Fig. 1). A pair of cuticular ornamentations, small, inconspicious at about mid level of glandular portion of pharynx (Fig. 12).

Male: Length 27 (25-30) mm, width at mid body 412 (317-476). Cephalic end 177 (156-245) long, 240 (215-260) wide. Posterior end of cuticular leaf 220 (208-266) from anterior extremity. Buccal capsule 269 (260-287) long; muscular portion of pharynx 435 (370-680) long, glandular portion 3229 (2975-3872) long. Deirids 307 (186-325), nerve ring 377 (338-410), excretory pore 499 (442-559), cuticular ornamentation (one measurement only) 2685 from anterior end. Posterior region curved ventrally. Caudal papillae arranged in 10 pairs, 4 pairs pre-anal, 6 pairs post anal, large pedunculate; 1st and 2nd pairs grouped together; 3rd and 4th pairs grouped together; 1st and 3rd more lateral; 8th and 9th pairs grouped together 9th more lateral; 10th pair close to tail tip. Longitudinal cuticular ridges present anterior to cloaca (Fig. 13). Spicules dissimilar; right spicule short robust, rounded distal tip 241 (208-266) (Fig. 9); left spicule, trifid distal tip 746 (682-813) long (Figs 4,14); longest spicule about 1:36 body length, tail 721 (598-845) (Fig. 11).

Female: Length 34.8 (30-41) mm, width at mid body 555 (510-629). Cephalic end 188 (156-201) long, 255 (240-273) wide. Posterior end of cuticular leaf 238 (188-260) from anterior extremity. Buccal capsule 282 (266-292); muscular portion of pharynx 461 (325-650) long, glandular portion 4040 (3111-4675). Deirids 336 (273-383), nerve ring 399 (357-422), excretory pore 500 (455-546) from anterior end. Vulva circular, without lips, 16.5 (13.6-19.4) mm from anterior extremity. Ovejector amphidelphic; vagina vera directed transversely, 550 (one measurement), vagina uterina 250 (one measurement) parallel to body wall (Fig. 6). Tail 621 (510-748) (Figs 7,10). Eggs thick shelled, 33.8 (32-34) by 48 (44-53).

Etymology

The specific name *vandycki* is given in recognition of Steve Van Dyck who first noticed the presence of these worms in the host.

Host: *Xeromys myoides*

Location: Stomach

Locality: Stradbroke Island, Queensland

Type specimens: Holotype male, QM211925; Allotype female, QM211926.

Paratypes: QM211927-30; SAM24832.

Remarks

Tikusnema vandycki can be distinguished from *T. javaense* by the shape of the cuticular leaves. In *T. vandycki* the leaves are subdivided at the edge into 4-5 teeth, but in *T. javaense* the leaves have three teeth, the middle one being the most prominent. *Tikusnema vandycki* can be further distinguished by its larger size; males up to 30 mm long, females up to 41 mm as compared with 21 and 24.5 in *T. javaense* respectively. The spicules of *T. vandycki* are longer (208-266 and 682-813) than those of *T. javaense* (190-210 and 500-570). However since *T. vandycki* is a larger worm than *T. javaense* the proportion of left spicule to body length is smaller for *T. vandycki* (1:36) than for *T. javaense* (1:18). Male *T. vandycki* have a shorter tail (598-845) than do *T. javaense* (840-990). The eggs of *T. vandycki* (44-53 x 32-34) are larger than those of *T. javaense* (38-44 x 28-31). Comparative measurements of *T. javaense* and *T. vandycki* are given in Table 1. Since the specimens examined by Hasegawa *et al.* (1992) are smaller immature adults only the measurements from Gibbons *et al.* (1992) of mature specimens are used. This allows an easier comparison of the relative sizes of mature adult specimens of each species. The paired cuticular ornamentations at the level of the glandular portion of the pharynx are tiny and difficult to find in *T. vandycki* but more prominent in *T. javaense*. The vagina vera of *T. vandycki* appears to consist of two parts, a globular heavily cuticularized part leading into a more tubular less cuticularized part, which in turn opens into vagina uterina (Fig. 6). The vagina vera of *T. javaense* is similarly figured in Gibbons *et al.* (1992). Further investigation is needed to determine whether the vagina vera is actually bipartite or whether the distal, globular part is actually an elaboration of the vulva.

Fourth stage larvae and immature adults of *T. vandycki* show similar morphological features to those of *T. javaense*. A detailed comparison and analysis, particularly of the development of the cephalic structures, is being prepared for a subsequent paper.

Discussion

The spirurid superfamily Acuarioidea is usually found in birds. However an increasing number of genera has now been reported from mammals. The genera *Stammerinema* Osche, 1955, *Antechiniella* Quentin & Beveridge, 1986, *Chandleronema* Little & Ali, 1980, and now *Tikusnema* occur exclusively in

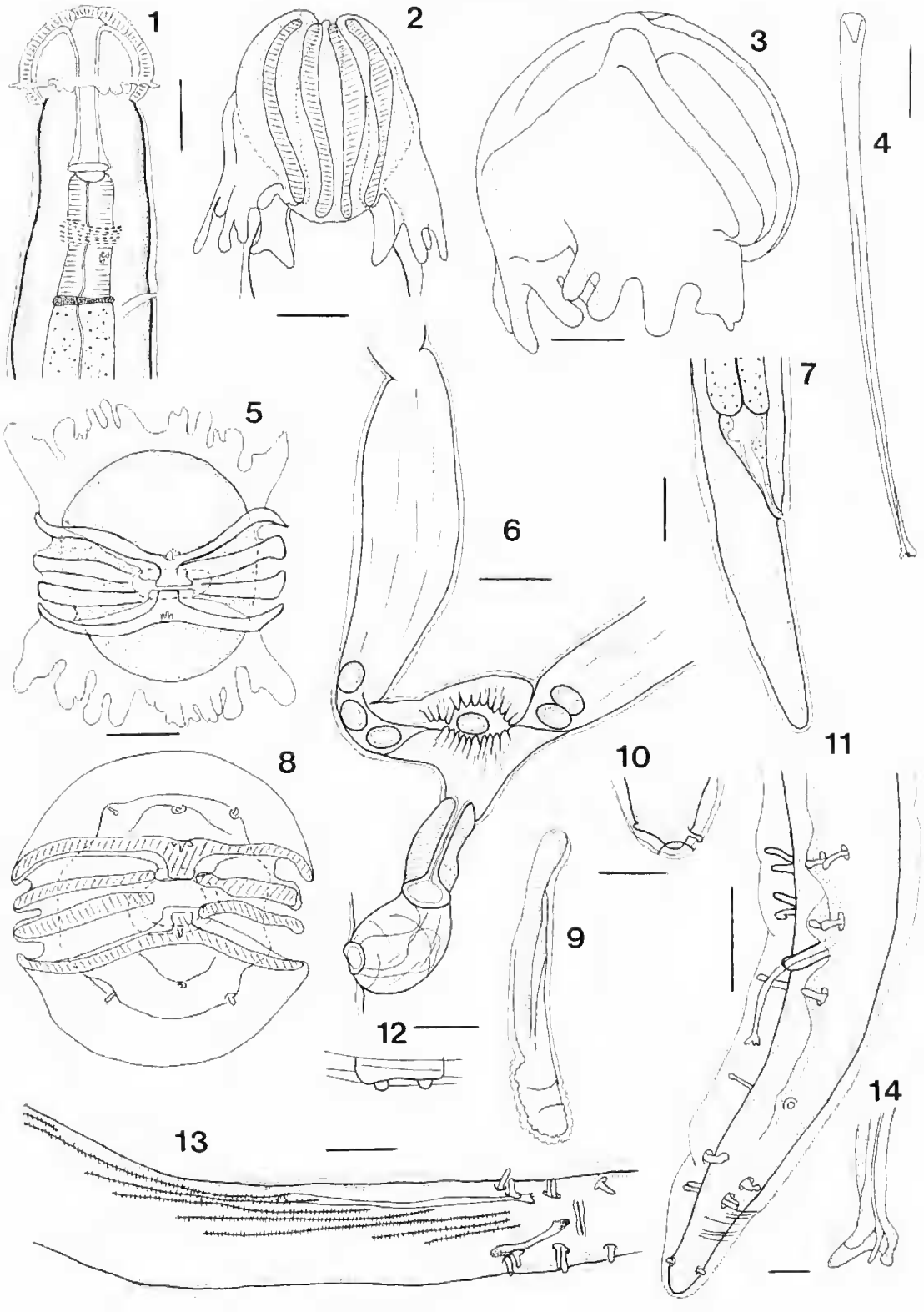
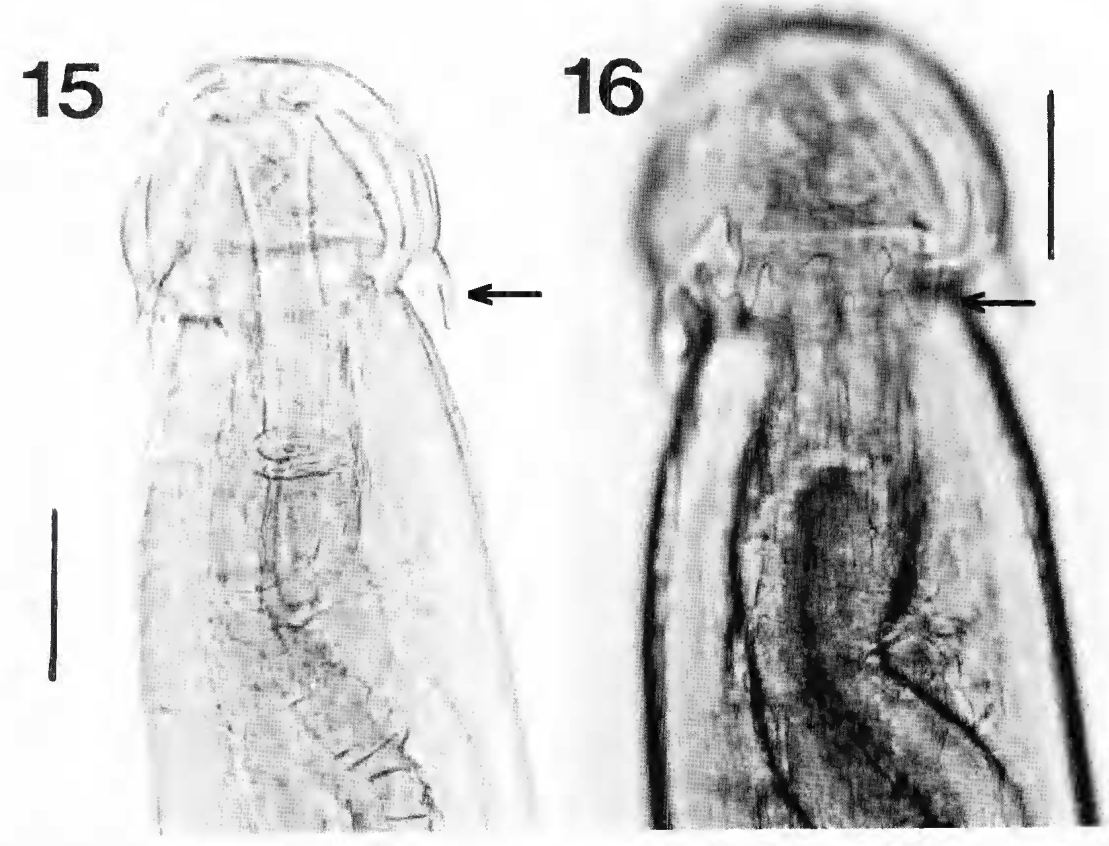

1
2
3
4
5
6
7
8
9
10
11
12
13
14

TABLE 1. *Mean measurements, in μm unless otherwise idicated, of* Tikusnema *species. Measurements of* T. javaense *are from Gibbons* et al. *1992. Standard deviations are given for the measurements of* T. vandycki.

	T. vandycki	*T. javaense*	*T. vandycki*	*T. javaense*
	Male		Female	
No. of specimens measured	10	4	10	2
Length in mm	27 ± 2.15	20.19	34.8 ± 3.16	23.5
Width	412 ± 43.39	410	555 ± 43.67	445
Length buccal capsule	269 ± 13.91	465	282 ± 31.55	515
Length muscular pharynx	435 ± 95.09	540	461 ± 89.07	585
Length glandular pharynx	3229 ± 383.86	1870	4040 ± 578.37	1935
Deirid to anterior end	307 ± 48.85	390	336 ± 33.15	410
Nerve ring to anterior end	377 ± 22.09	550	399 ± 24.96	585
Excretory pore to anterior end	499 ± 37.45	765	500 ± 27.58	825
Right spicule	241 ± 19.73	200	-	-
Left spicule	746 ± 53.62	535	-	-
Tail	721 ± 67.32	915	621 ± 65.41	505
Vulva to anterior end in mm (one specimen)	-	-	16.5	12.21



Figs 15,16. Photomicrographs of the anterior end of *Tikusnema vandycki* sp. nov. lateral aspects. Fig. 15. optical section. Fig. 16. showing the cuticular leaves of the pseudolabia. Scale bars = 100μm. Arrows indicate cuticular leaves.

Figs 1-14. *Tikusnema vandycki* sp. nov. Fig. 1 Anterior end, lateral view. Fig. 2. Cephalic region, dorsal view. Fig. 3. Cephalic region, lateral view. Fig. 4. Left spicule. Fig. 5. Cephalic region, enface view showing cuticular leaves. Fig. 6. Vulva, vagina and uteri, lateral view. Fig. 7. Posterior end female, lateral view. Fig. 8. Cephalic end, enface view, optical section showing cordons. Fig. 9. Right spicule. Fig. 10. Female tail tip. Fig. 11. Posterior end male, lateral view. Fig. 12. Cuticular ornamentation in pharyngeal region. Fig. 13. Posterior end male, ventral view showing cuticular ridges arising anterior to the cloaca. Fig. 14. Left spicule tip. Scale bars: Figs 1,6,4, = 100 μm; Figs 2,3,5,8, = 50 μm; Figs 7,11,13, = 200 μm; Figs 9,10,12, = 50 μm; Fig. 14, = 25μm.

mammals (Gibbons *et al.* 1992) while others, *Synhimantus* Railliet, Henry & Sissoff, 1912, *Paracuaria* Rao, 1951 and *Skrjabinoclava* Sobolev, 1943 although primarily found in birds, also occur in mammals. Various arthropods and fish serve as intermediate hosts for the life cycle stages of acuariids (Anderson 1992). The link between mammalian host and acuariid parasite therefore may be one of dietary habit (Smales 1991). A particular set of dietary preferences and habits of a few mammals thus allows these odd occurrences of infection by acuariids of biologically unrelated host species, in geographically unrelated regions of the world. Shrews from Bulgaria, Israel, Alaska, Europe; rice rats, raccoons, muskrats, from USA; rice field rats from Indonesia; pyrenean desmans from Spain; *Antechinus* species, water-rats and false water-rats from Australia are all able to be parasitized by acuariids under appropriate circumstances (Quentin & Beveridge 1986; Hasegawa *et al.* 1992; Alvarez *et al.* 1994; Anderson & Wong 1994). The precise nature of the link would probably differ from one mammalian host to another. For example the diet, including crustaceans, and semi-aquatic habits of *X. myoides* appear to fit the required pattern.

Australian rodents are all included within the family Muridae. Their ancestors are believed to have evolved in South-east Asia about 25 million years ago (Watts & Aslin 1981). Then some 15-20 million years ago members of the lineage colonized the Indonesian and possibly some Melanesian islands. Geological changes during this period isolated the islands for greater or lesser periods of time allowing further speciation to occur. By 5-10 million years ago Australia and New Guinea had moved close enough to these islands to allow colonization by what has become known as the old endemic rodents.

The Australian water rat group, the Hydromyini form part of that old endemic fauna. The suggested period of divergence within the group (Watts & Aslin 1981) would have the Australian and false water-rats evolving along separate lineages before their arrival in Australia. Both genera have closer affinities with various New Guinean rat species, in body form and ecological niche, than they do with each other. The fact that both genera have acuariid parasites can be seen as a reflection of their aquatic to semi-aquatic life-styles and the inclusion of crustaceans in their diet. However, the acuariids found in *H. chrysogaster*, *Antechiniella* and *Synhimantus* are also found in Australian dasyurid marsupials whilst *Tikusnema* from *X. myoides* also occurs in *R. argentiventer* from Indonesia. This is consistent with the scenario proposed by Watts & Aslin (1981) that *X. myoides* is a more recent arrival in Australia than *H. chrysogaster*. How the radiation of the Hydromyini is related to the murids of Southeast Asia is unknown (Watts & Kemper 1989). A survey of the parasites of the Papua New Guinean Hydromini is needed to determine which, if any, acuariid parasites are present. Conclusions may then be able to be drawn as to whether the appearance of *Tikusnema* in *R. argentiventer* and *X. myoides* has any significant bearing on murid relationships in South-east Asia, Papua New Guinea and Australia.

Acknowledgments

My thanks to Steve Van Dyck and Lester Cannon of the Queensland Museum for giving me access to the material from the false water-rat, Dr Ralph Lichtenfels of the Biosystematic Parasitology Laboratory and Dr Lynda Gibbons of the International Institute for Parasitology for the loan of the material.

References

ANDERSON, R. C. (1992) "Nematode parasites of vertebrates. Their development and transmission" (CAB International, Cambridge).

_____ & WONG, P. L. (1994) *Skrjabinoclava kinsellai* n.sp. (Nematoda: Acuarioidea) from the rice rat *Oryzomys palustris* in Florida. *Syst. Parasitol.* **28,** 1-4.

ALVAREZ, F., GIBOR-BOTELLA, H., QUINTEIRO, P., REY, J., LOPEZ-ROMAN, F. & SANMARTIN, M. L. (1994) *Paracuaria hispanica* n.sp. (Nematoda: Acuariidae), a stomach parasite of the pyrenean desman *Galemys pyrenaicus* Geoffr. (Insectivora: Talpidae), with a redefinition of the genus *Paracuaria* Rao, 1951. *Ibid.* **29,** 105-112.

BIRD, A. F. & BIRD, J. (1991) "The Structure of Nematodes" 2nd edtn. (Academic Press, San Diego).

GIBBONS, L. M., CRAWSHAW, M. T. & RUMPUS, A. E. (1992) *Molinacuaria indonesiensis* n.sp. (Nematoda Acuarioidea) from *Rattus argentiventer* in Indonesia. *Syst. Parasitol.* **23,** 175-181.

HASEGAWA, H., SHIRAISHI, S. & ROCHMAN (1992) *Tikusnema javaense* n.gen., n.sp. (Nematoda: Acuarioidea) and other nematodes from *Rattus argentiventer* collected in West Java. *J. Parasitol.* **78,** 800-804.

QUENTIN, J. C. & BEVERIDGE, I. (1986) Comparative morphogenesis of the cephalic structures of the acuariid nematodes *Stammerina soricis* (Tiner, 1951), *Antechiniella suffodiax* (Beveridge & Barker, 1975) n.gen., n.comb and *Skrjabinoclava thapari* (Teixeira de Freitas, 1953). *Syst. Parasitol.* **8,** 163-171.

SMALES, L. R. (1991) A new species of *Antechiniella* Quentin & Beveridge, 1986 (Nematoda: Acuariidae) from the Australian water rat *Hydromys chrysogaster* Geoffroy, 1804. *Trans. R. Soc. S. Aust.* **115,** 217-220.

VAN DYCK, S. (1992) Parting the reeds on Myora's *Xeromys* kibbutz. *Wild. Aust.* **29,** 8-10.

_____ (1994) The rats at neptune's table. *Aust. Nat. Hist.* **24,** 30-37.

WATTS, C. H. S. & ASLIN, H. J. (1981) "The Rodents of Australia" (Angus & Robertson, London).

_____ & KEMPER, C. M. (1989) Muridae pp. 939-957 *In* Walton, D. W. & Richardson, B. J. (Eds) "Fauna of Australia" Vol 1B Mammalia (Aust. Govt. Publishing Service, Canberra).

WONG, P. L. & LANCASTER, M. W. (1985) Revision of the genus *Ancyracanthopsis* Diesing, 1861 and description of a new genus *Molinacuaria* n.gen. (Nematoda: Acuarioidea). *Can. J. Zool.* **63,** 1556-1564.